USATLAS Plans for Muon Phase-II Upgrade

Tom Schwarz (UM)
L2 Construction Manager for Phase II Muons

Anyes Taffard (UCI)
L2 R&D Manager for Muons

Point of the Meeting

- Present to the USATLAS muon community the ***proposed*** plan for US contributions to the Phase II upgrade
- Outline known or anticipated interests from US institutions
- Present known international competition
- Discuss our next milestone and how to get started

This is a working meeting - feel free to ask questions, disagree, etc. If I don't know the answer I'll try to dig it up

Scope of the Phase II Muon Upgrade

Phase II upgrades to the muon spectrometer are required to handle increased rates and fakes associated with HL-LHC luminosities (7×10^{34} $cm^{-2}s^{-1}$) and the new ATLAS wide L0/L1 trigger system

- **To cope with high rates, the readout of the MDT system must be replaced, as well as the barrel (RPC) and end-cap (TGC) triggering system**
- **To reduce fakes**
  - **p_T selectivity of tracks for the trigger will be improved by integrating MDT information into the L1 (possibly L0) trigger**
  - **To reduce fakes at high η ($2 < |\eta| < 2.4$), new sTGC's will be installed in the inner ring of the big wheel**
- **To extend muon system lifetime**
  - **Gas gain in RPC's will be lowered to meet design limitations (0.3 C/cm^2), and new RPC's will be installed in the inner layer of the barrel to maintain trigger efficiency and increase acceptance**
  - **HV and LV power supplies will be replaced to ensure operation of the muon spectrometer at the HL-LHC through 2035**

Scope of the Phase II Muon Upgrade

Phase II upgrades to the muon spectrometer are required to handle increased rates and fakes associated with HL-LHC luminosities ($7x10^{34}$ $cm^{-2}s^{-1}$) and the new ATLAS wide L0/L1 trigger system

- ➡ <u>To cope with high rates</u>, the readout of the MDT system must be replaced, as well as the barrel (RPC) and end-cap (TGC) triggering system
- ➡ <u>To reduce fakes</u>
  - ➡ p_T selectivity of tracks for the trigger will be improved by integrating MDT information into the L1 (possibly L0) trigger
  - ➡ To reduce fakes at high η ($2 < |\eta| < 2.4$), new sTGC's will be installed in the inner ring of the big wheel
- ➡ <u>To extend muon system lifetime</u>
  - ➡ Gas gain in RPC's will be lowered to meet design limitations (0.3 C/cm2), and new RPC's will be installed in the inner layer of the barrel to maintain trigger efficiency and increase acceptance
  - ➡ HV and LV power supplies will be replaced to ensure operation of the muon spectrometer at the HL-LHC through 2035

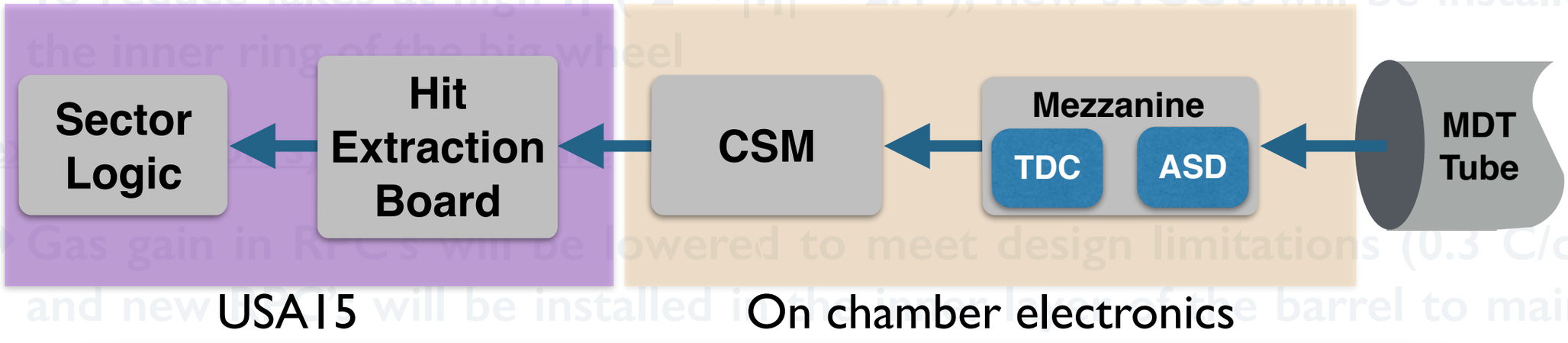
Scope of the Phase II Muon Upgrade

Phase II upgrades to the muon spectrometer are required to handle increased rates and fakes associated with HL-LHC luminosities ($7x10^{34}$ $cm^{-2}s^{-1}$) and the new ATLAS wide L0/L1 trigger system

➡ To cope with high rates, the readout of the MDT system must be replaced as well as the barrel (RPC) and end-cap (TGC) triggering system

➡ To reduce fakes

➡ p_T selectivity of tracks for the trigger will be improved by integrating MDT information into the L1 (possibly L0) trigger



With US expertise, we can take on the most important components of the Muon Upgrade with a modest budget

Scope of the Phase II Muon Upgrade

ATLAS to present "scoping document" to the LHCC in September

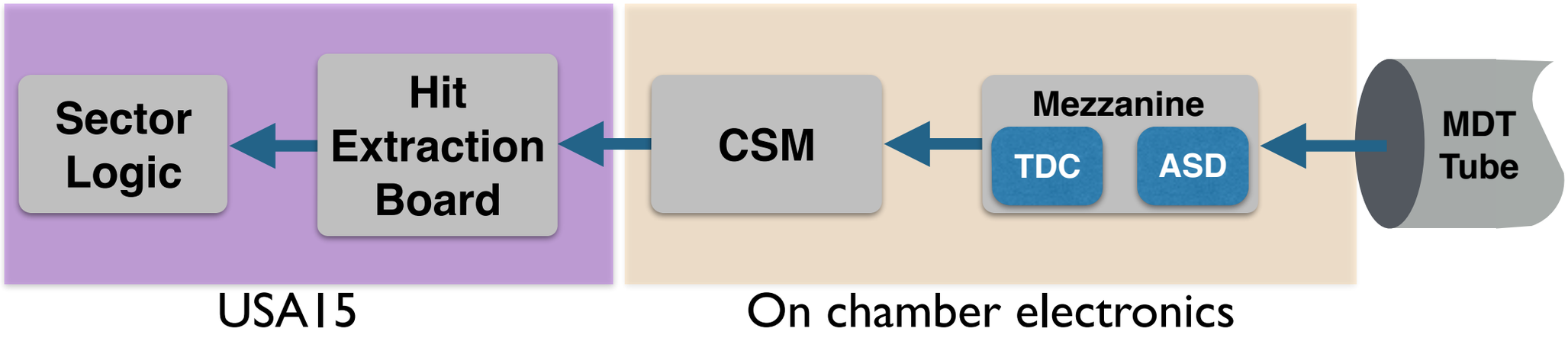
Draft/outline: https://indico.cern.ch/event/397459/

	LoI	Low	Medium	High
TGC electronics	yes	yes	yes	yes
RPC electronics	yes	yes	yes	yes
MDT electronics	BM,BO,EM	BM,BO,EM	BM,BO,EM	all
MDT L0 trigger	2-station	2-station	2-station	3-station
* sTGC BW inner ring	yes	yes	yes	yes
RPC on BI	no	no	BI4 to BI6	yes
sMDT on BI	no	no	BI4 to BI6	yes
High-Eta tagger	no	no	no	yes
Power system	no	yes	yes	yes

* ***Front End VMM already contributed for this in Phase I NSW***

Interests of US Institutions

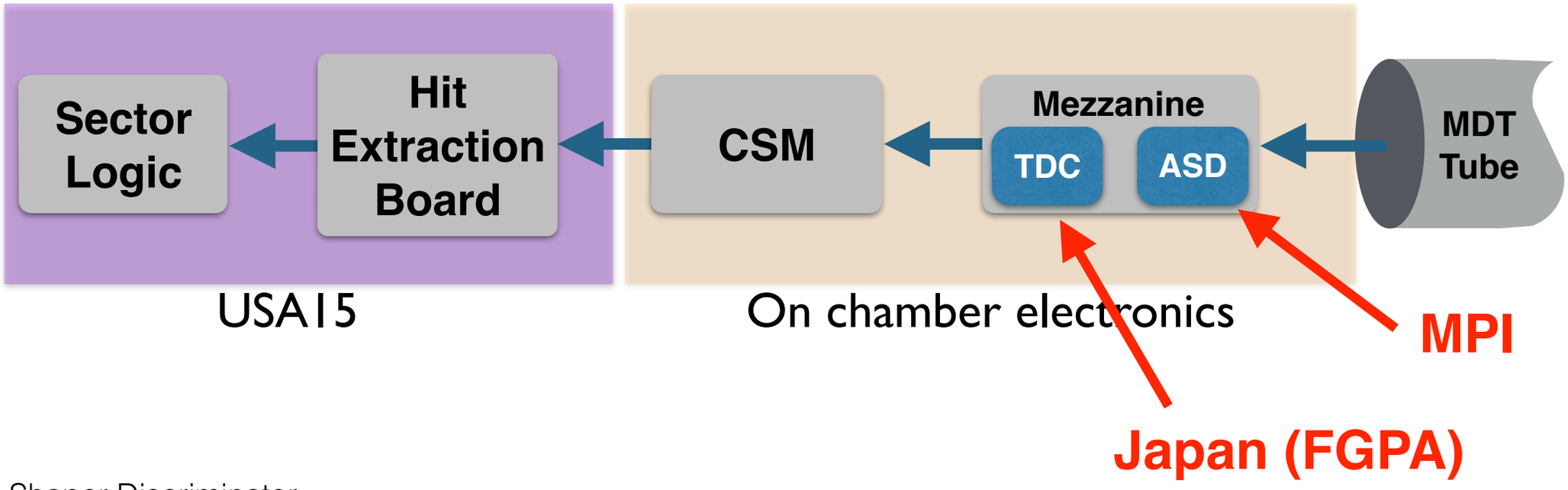
R&D WBS	Construction WBS	Description	Institution
4.5.3	6.5.1	CSM	Michigan
4.5.5 (new)	6.5.2	FE ASIC	BNL/Michigan (ASIC), BU (FPGA)
4.5.6 (new)	6.5.3	FE Mezzanine	Arizona, BU
4.5.7 (new)	6.5.4	Hit Extraction Board	UIUC
4.5.8 (new)	6.5.5	Add MDT to trigger	UCIrvine



ASD: Amplifier Shaper Discriminator
TDC: Time to Digital Converter (drift time measurement)

International Competition

R&D WBS	Construction WBS	Description	Institution
4.5.3	6.5.1	CSM	Michigan
4.5.5 (new)	6.5.2	FE ASIC	BNL/Michigan (ASIC), BU (FPGA)
4.5.6 (new)	6.5.3	FE Mezzanine	Arizona, BU
4.5.7 (new)	6.5.4	Hit Extraction Board	UIUC
4.5.8 (new)	6.5.5	Add MDT to trigger	UCIrvine



ASD: Amplifier Shaper Discriminator
TDC: Time to Digital Converter (drift time measurement)

How to get Started

- Our current milestone is the TDR, which will is scheduled for roughly 2017/18 - we should contribute significant US R&D for this document on every WBS item

- We need to better define what we plan to do in construction and what we need to do during R&D to make that happen

  - TO DO:

➡ Send Anyes and myself an email with a rough idea of where you would like to contribute to in Phase II and how soon you anticipate requiring R&D funding

➡ Within the next two months (by August 31st), provide a few pages of what your institution specifically wants to do for Phase II construction, and what R&D you need to do to make that happen - along with estimated budgets

I have attached Michigan's proposal to this indico site as a reference

A Comment on Budgets

With US expertise, we can take on the most important components of the Muon Upgrade with a modest budget

- USATLAS Muon Scope for Phase II has been enthusiastically received - we need to build on our momentum

- A few things to note:

  - Most of you will first propose for R&D funds for FY17 - this is a very difficult year (as opposed to FY18). We suggest to tailor your plans and how you use your personnel (delay what you can to FY18).

- The USATLAS construction budget is limited to roughly 20% of the core costs of the total ATLAS upgrade. For muons this means we want to be around $5-10M total. Don't worry about specifics yet, this just sets the scale.